

Investigation 4

Calculator Tables and Graphs

In the last investigation, you wrote equations to describe patterns and to show how variables are related. Such equations are used in mathematics, science, economics, and many other subject areas. Tables, graphs, and equations are all useful ways of representing relationships between variables. When you have an equation relating variables, you can use a *graphing calculator* to make a graph or table of the relationship quickly.

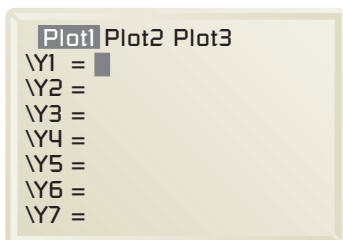


4.1 Making and Using Calculator Tables

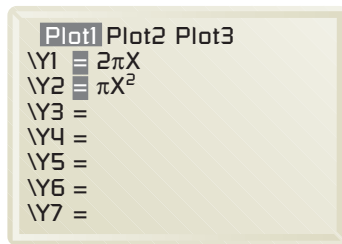
Suppose you want to use your calculator to make a table of values for the formulas for the circumference C and area A of a circle with radius r :

$$C = 2\pi r \text{ and } A = \pi r^2.$$

To enter the equations into your calculator, press **Y=** to get a screen like the one below.



On most calculators, you enter the independent variable as X; the dependent variable is Y. Enter the equation for circumference as Y1 and the equation for area as Y2 as shown below.



Next, press **2nd** **TblSet** and enter the table settings shown below. The settings indicate that the x-values (radius values) in the table should start at 0 and increase in steps of 1.



Press **2nd** **TABLE**, and you will see the table.

X	Y ₁	Y ₂
0	0	0
1	6.2832	3.1416
2	12.566	12.566
3	18.85	28.274
4	25.133	50.265
5	31.416	78.54
6	37.699	113.1

X=0

You can use the scroll keys to see more values for radius, circumference, and area.

Getting Ready for Problem 4.1

- What does the number 28.274 in the third column mean?
- What does 25.133 in the second column mean?
- What does 5 in the first column mean?

In the following problem, you will use calculator tables to explore relationships between variables. You will scan the tables to solve problems or look for interesting patterns in the entries.

Problem 4.1 Making and Using Calculator Tables

- A.** The equation $p = 50 + 10n$ represents the Wild World admission price in dollars p for a group of n people. To study this relationship, enter the equation $Y1 = 50 + 10X$ into your calculator.
1. Make a calculator table showing (n, p) values for $n = 1, 2, 3$, and so on.
 2. Scan the table to find the admission price for a group of 26 people.
 3. Find the value of n for which $p = 480$. Explain what this entry tells you about the admission price and the number of people.
 4. Use the table to find the value of n for which $950 = 50 + 10n$. Explain what this table entry tells you about the admission price and the number of people.
- B.** The equation $d = 2.5t$ represents the distance a canoe team paddles in meters d in t seconds.
1. Make a calculator table showing (t, d) values for $t = 4, 8, 12$, and so on.
 2. Use the table to find the distance the team paddles in 40 seconds.
 3. Use the table to find the value of t for which $2.5t = 437.5$. Explain what this entry tells you about the time and distance traveled.
- C.** The equation $b = 100 - 6r$ gives the number of bonus points b left on a Wild World bonus card after r rides.
1. Make a calculator table showing (r, b) values for $r = 0, 2, 4$, and so on.
 2. How does the number of bonus points change as the number of rides increases in steps of 2? Why does that pattern occur?
 3. Use your table to find a value of r for which $100 - 6r = 10$. (Adjust the table settings if you need to.) Explain what this entry tells you about the number of rides and the bonus points left on the card.



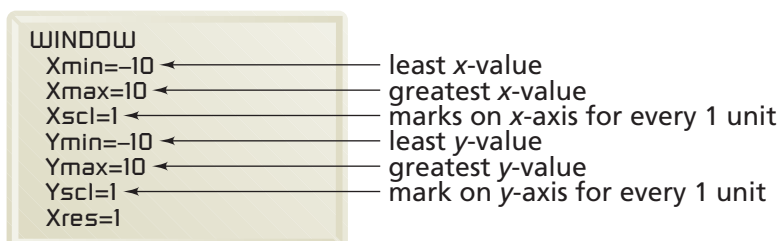
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4.2

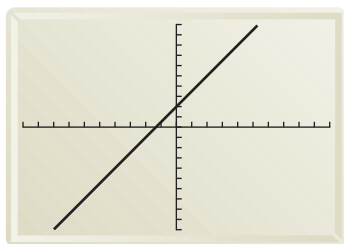
Making and Using Calculator Graphs

Graphing calculators can help you make and study graphs. Just as when you make a graph with pencil and paper, the key step is choosing ranges and scales for the axes.

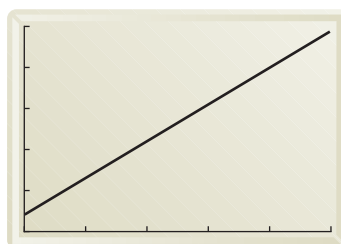
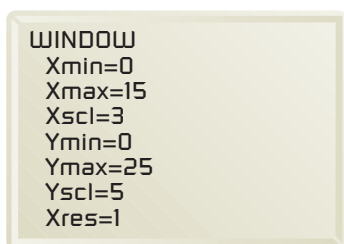
Suppose you want to graph $y = 1.5x + 2$. Press **Y=** and enter the equation, just as you do when you make a table. Next, set the boundaries of the graphing window. Press **WINDOW** to see the screen below. The settings shown here are the *standard* window settings.



Press **GRAPH** to see what the graph looks like in this window.

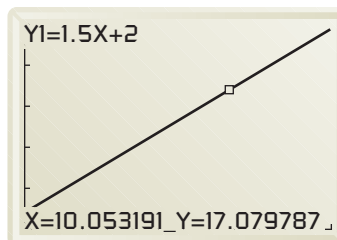


Suppose you want to focus on the part of the graph that shows positive x - and y -values. Press **WINDOW** again and change the settings. Use the settings shown below at the left. Then press **GRAPH** to see the screen on the right.



To find coordinates of particular points on the graph, press **TRACE**. Use the arrow keys to move the cursor along the graph and see coordinates of highlighted points.

When the cursor is on the line, the coordinates appear at the bottom of the screen and the equation appears in the upper left.



Getting Ready for Problem 4.2

Experiment with your graphing calculator and the following equations. Graph one set of equations at a time. Use the standard window.

Set 1
$y = 3x - 4$
$y = x^2$
$y = 3x + 2$

Set 2
$y = 5$
$y = 3x$
$y = 1x$

Set 3
$y = 2x + 3$
$y = 2x - 5$
$y = (0.5)x + 2$

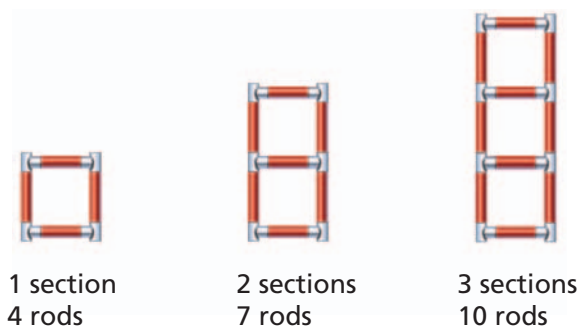
Set 4
$y = 2x$
$y = 2 \div x$
$y = 2^x$

Answer the following questions for each set of equations.

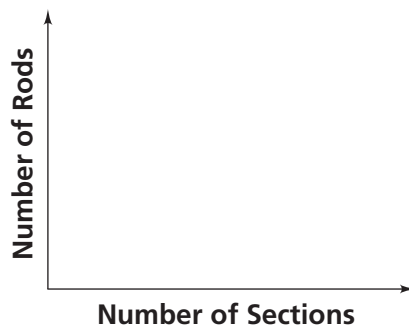
- Which, if any, of the graphs show similar patterns of change? How are the graphs similar? How are the equations for the graphs similar?
- How are the graphs different? How are the equations for the graphs different?

Problem 4.2 Making and Using Calculator Graphs

- A.** One popular attraction at Wild World is the climbing wall. Supports for the wall are frames of squares made from steel rods. The number of rods depends on the number of square sections in the frame.



1. An engineer at Wild World wrote the equation $r = 3s + 1$ to relate the number of sections and the number of rods. Do you think this formula is correct? Explain. What does each variable in the equation represent?
2. Use your calculator to graph the engineer's equation. Use the window settings $X_{\min} = 0$, $X_{\max} = 15$, $Y_{\min} = 0$, and $Y_{\max} = 50$. Sketch your graph on axes like these. Give your graph a title.



3. Press **TRACE** and use the arrow keys to move along the graph. Locate a point with a y-value of about 19. Mark this point on your sketch and label it with its coordinates. Then, find a point with a y-value of about 43. Mark and label this point on your sketch.
 4. Explain what the coordinates of each point in part (3) tell you about the number of sections and the number of rods.
 5. Use your calculator graph to find a value of s for which $3s + 1 = 28$. Give the coordinates of that point, and explain what they tell you about sections and rods.
- B.** Make a calculator graph of $b = 100 - 6r$, which gives the bonus card balance b after r rides. Experiment with the window settings until you have a good view of the graph. (You might find it helpful to look at the table you made in Problem 4.1.)
1. Make a sketch of the graph. Label the axes with variable names and scales. Add a descriptive title to your graph.
 2. Find a point on the calculator graph for which $b \approx 58$. (The symbol \approx means "is approximately equal to.") Mark this point on your sketch and label it with its coordinates. Explain what the coordinates tell you about the number of rides taken and the balance on the card.
 3. Use your calculator graph to find a value of r for which $100 - 6r \approx 22$. Give the coordinates of that point and explain what they tell you about the rides taken and the card balance.

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4.3 Extending the Tour

The bike tour was a success! So many people signed up for the tour that the students decide to offer an additional two-day bike tour. Two bike rental companies submit bids to the students. Their price quotes are shown here.

CYCLE THE COAST
Bike Sales and Rentals

123 Surf Street
555-bike

Price Quote for Ocean Bike Tours

Bikes delivered and picked up
each day for two days.

Price: \$25 per bike for two days


Speedy Wheels

SPEEDY WHEELS
Bikes and Skateboards
72 Market Street
555-spin

PRICE QUOTE

Customer: _____ Ocean Bike Tours

Item: _____ Touring bikes, various sizes

Time: _____ 2 days

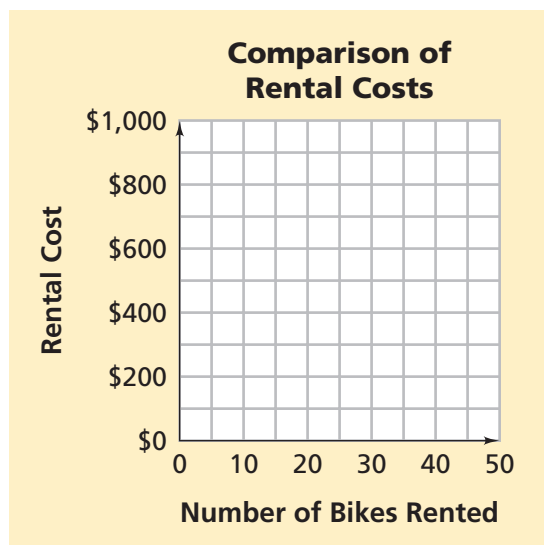
Price: _____ \$100 for pickup and delivery,
plus \$20 per bike for two days

In the next problem, you will use your graphing calculator to analyze the price quotes and advise Ocean Bike Tours about which company to use.

Problem 4.3 Comparing Relationships

Study the price quotes from the two companies. The following questions will help you analyze the information.

- A. Make a table showing the costs for renting bikes from each company. Include costs for 5, 10, 15, 20, 25, 30, 35, and 40 bikes in your table.
- B. Plot the (*number of bikes, rental cost*) data for both companies on a graph like the one below. Use a different color or plotting symbol for each company.



- C. For each company, write an equation relating the number of bikes rented to the total cost. Tell what the letter variables in your equation represent.
- D. Enter your equations into your calculator as Y1 and Y2. Graph both equations in the same window. Compare the calculator graph with the graph you made by hand.
- E. Is there a number of bikes for which both companies charge the same rental fee? How can the graph help you find the answer?
- F. How does the graph show the number of bikes for which Cycle the Coast is the most economical? How does it show the number of bikes for which Speedy Wheels offers the better deal?
- G. What advice would you give Ocean Bike Tours about which company to rent bikes from? Use your analysis of the two plans to justify your advice.

AC Homework starts on page 72.